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A Coded Wire Tag Assessment of Salmon River (Langley) Coho Salmon: 1986 Tag Application and 1987 Spawner Enumeration

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by

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ABSTRACT

Schubert, N.D. and L.W. Kalnin. 1990. A coded wire tag assessment of Salmon River (Langley) coho salmon: 1986 tag application and 1987 spawner enumeration. Can. MS Rep. Fish. Aquat. Sci. 2053: 43 p.

In 1986, the Department of Fisheries and Oceans began implementation of a plan to improve the assessment data base for coho salmon (**Oncorhynchus kisutch**) through the long term evaluation of key stocks. The Salmon River (Langley) was selected for the evaluation, with known precision, of annual escapement, marine survival, harvest distribution and exploitation rate. An estimated 10,059 coho smolts were released with coded wire tags (CWT) in spring of 1986 at an average size of 98.8 mm and 9.3 g. The adult escapement was estimated in fall/winter 1987-88 using the Petersen mark-recapture method. Escapement was estimated at 11,974, of which 319 had CWTs and 87 (21.6%) had lost the CWT. Survival to escapement was 4.0%.

Key Words: Coho salmon, Salmon River (Langley), key stream, coded wire tag, escapement, survival.

RÉSUMÉ

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En 1986, le Ministère des Pêches et Océans a entrepris la mise en oeuvre d'un plan d'amélioration de la base de données sur le saumon coho (**Oncorhynchus kisutch**) en faisant une évaluation à long terme des stocks clés. Il a choisi de faire cette évaluation dans la rivière Salmon et d'établir des données précises sur l'échappée annuelle, la survie, la répartition des captures et le taux d'exploitation. Au printemps de 1986, environ 10 059 jeunes saumons mesurant en moyenne 98,8 mm, pesant en moyenne 9,3 g et pourvus d'une micromarque magnétisée codée ont été relâchés. L'échappée des adultes a été estimée à l'automne et au printemps de 1987-88 à l'aide de la technique Petersen de marquage-recapture. Sur le groupe constituant l'échappée estimée à 11 947, 319 avaient encore leur micromarque et 87 (21,6%) l'avaient perdue. La survie à l'échappée était de 4,0%.

Mots clés: Saumon coho, rivière Salmon (Langley), cours d'eau important, micromarque magnétisée codée, échappée, survie.

INTRODUCTION

The management of coho salmon (**Oncorhynchus kisutch**) in British Columbia is largely passive, with harvest management plans established in the absence of harvest rate or escapement goals. The development of more sophisticated approaches is inhibited by the quality of stock assessment information. Coho salmon are recognized as among the most difficult salmon species to study, due both to the mixed stock nature of their marine distribution and to spawner characteristics which make escapement estimation difficult (Anon. 1969, 1984). As a result, improved stock assessment, an important prerequisite for active management, is required to define current stock status and to evaluate future management actions.

Improved assessment of British Columbia coho salmon will result from the intensive monitoring of a group of key stocks selected to represent all British Columbia coho stocks. The status and response to management actions of these stocks will be evaluated by measuring, with known precision, annual escapements, marine survivals, harvest distributions and exploitation rates.

The Salmon River was designated a key stream in 1986 for three reasons. First, recent escapements of Salmon River coho comprised 4% of the Fraser River total (Farwell **et al.** 1987). The status of this stock, therefore, is an important measure of the status of the Fraser River coho resource. Second, similar data collected from the 1976-78 brood years (Schubert 1982a; Schubert and Fleming 1989) provide a time series of comparable data. Third, simplified logistics limited project costs.

This report documents, for the 1984 brood, the 1986 coho smolt trapping and coded wire tag (CWT) application and 1987 coho adult escapement estimation studies. The report describes field methodologies, analytic techniques and study results, including smolt timing, age and size and adult age, length, sex, adipose fin clip (AFC) incidence and estimates of escapement and long term CWT loss. The study did not estimate the escapement of precocious males (jacks). The report concludes with a discussion of data limitations and recommendations for future studies.

STUDY AREA

The Salmon River flows in a northwesterly direction for 33 km, entering the Fraser River west of Fort Langley (Fig. 1). Coghlan Creek, the principal tributary, joins the mainstem 14 km upstream from the Fraser River. The system, with an average annual discharge of 1.41 m^3/s (Environment Canada 1986), drains 85 km^2 of lowland agricultural and residential land. In the upper reaches, the river is marshy with low summer flows. In the middle reaches, the river flows across low gradient terrain in a shaded, meandering channel. In the lower 10 km, the river is slow and deep as it flows in a series of tortuous meanders across meadowland. During the Fraser River spring freshet, the Salmon River passes through a pumphouse located at the river mouth. No provisions were made for fish passage. Pump mortalities of up to 31% (Russell MS 1981) occur when coho smolts pass through the pumps.

The Salmon River supports several anadromous and freshwater species, with coho salmon dominant (Hartman 1969; DeLeeuw MS 1981; Schubert 1982a). Coho adults enter the river at ages 3_2 and 4_3 and spawn in the middle and upper reaches from November to January (Schubert 1982b; Schubert and Fleming 1989). Coho escapements averaged 3,000 and 2,400 in 1970-79

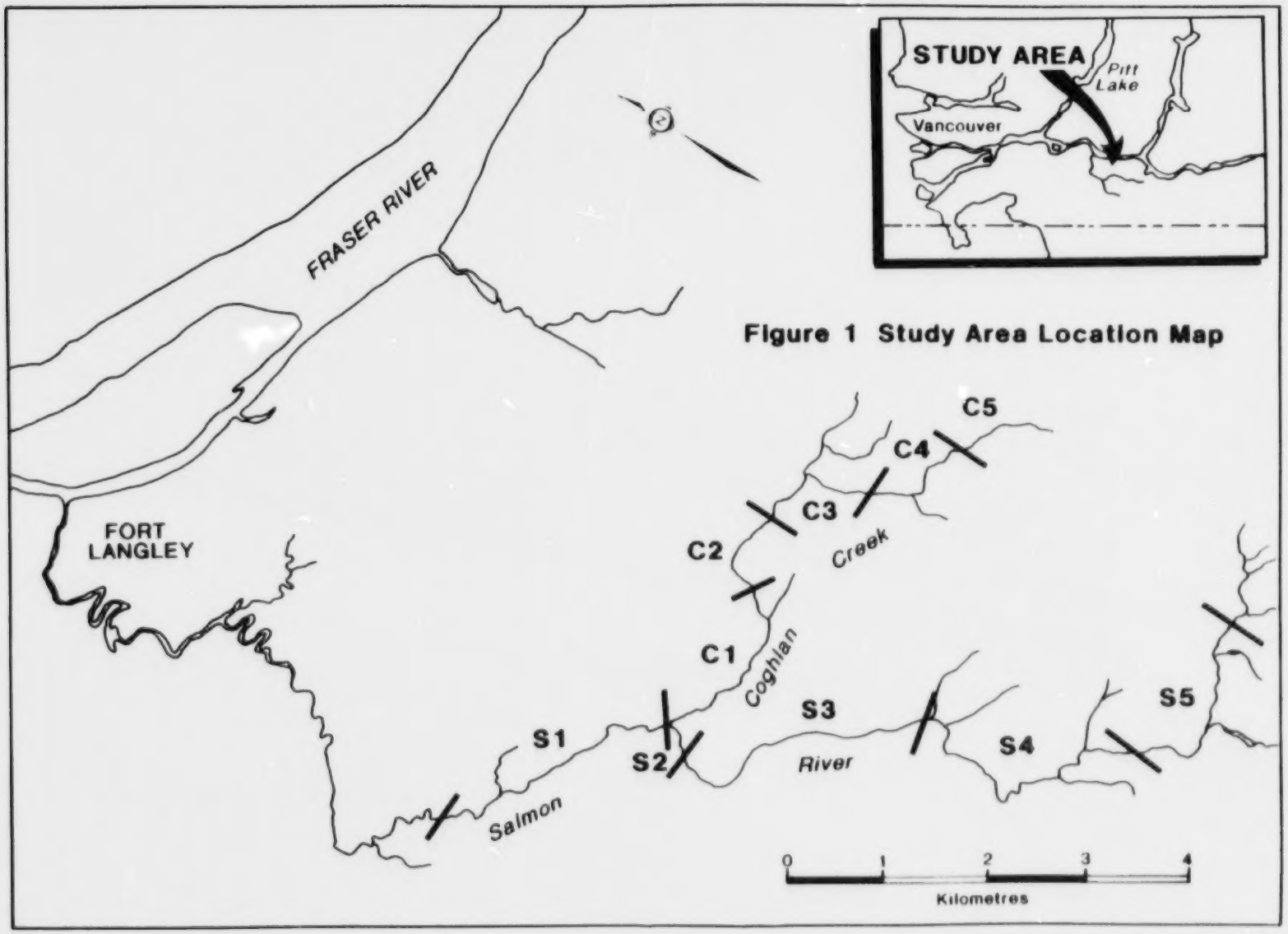

Figure 1 Study Area Location Map

and 1980-86, respectively (Farwell et al. 1987).

METHODS

JUVENILE PROGRAM

Fish Capture

Traps similar to those described by Schubert (1982a) operated in Coghlan Creek from April 17 to June 17, 1986 and in the Salmon River from April 17 to June 10, 1986. The Coghlan Creek trap was located 100 m above the Salmon River. The Salmon River trap was located 75 m above the Coghlan Creek confluence.

Captured fish were enumerated at least once daily. Coho smolts were transferred to holding boxes or to the tagging site for tagging and sampling. Coho fry were not enumerated because the 6 mm fence mesh did not fully restrict their passage. The remaining catch was identified to species and released below the trap. Trout were recorded as smolt or presmolt, based on size and parr marks, but were not identified to species.

Coded Wire Tagging

The CWT equipment and maintenance procedures were described by Armstrong and Argue (1977). Coded wire tagging occurred from April 23 to June 6, 1986 at intervals of one to seven days. On each day, the smolts were sorted by size (nose-fork length greater or less than 100 mm) and separate nose molds and implant depths were used for each group. Implant depth was checked for each group by bisecting the skull of a coded wire tagged smolt along the median plane. If the CWT was not in the preferred position in the cartilaginous wedge of the skull, the implant depth was adjusted and the procedure repeated until CWT placement was correct. Each group was then separated into three replicates, with each receiving a unique CWT code. The smolts were anesthetized with Tricaine Methane Sulfonate (TMS), marked by adipose fin removal, coded wire tagged and passed through a quality control device to ensure the CWT was present. Any diseased or damaged smolts were released untagged. Coded wire tagged fish were then retained 24 hours for assessment of AFC quality, delayed mortality and CWT loss. Any coho without a CWT or with a poor AFC was retagged or reclipped. All smolts were then transported and released.

Transport

Coded wire tagged smolts were released at the Salmon River mouth to avoid pump related mortality. The smolts were transported in five gallon plastic buckets supplied with air from a twelve volt air pump. Transport required less than fifteen minutes.

Sampling

Fifty coho smolts per site were sampled twice weekly for scales, length and weight. The smolts were anesthetized with TMS, a scale smear was removed with a scalpel from each preferred region, nose-fork length was measured to the nearest millimeter and mean wet weight was determined in aggregate on an Ohaus triple beam balance.

ADULT PROGRAM

Fish Capture

Coho adults were captured twice per week in reaches S1, S2, S3, S4 and C1 (Fig.1) from October 28 to December 18, 1987. Coho were attracted from log jams and cut banks with an electroshocker using direct current.

Voltage (600 volts) and frequency (15 to 30 milliseconds) were adjusted daily to ensure the fish were undamaged, but stunned sufficiently to permit capture. Stunned coho were captured in a dip net, permitted to recover in a 60 l container of water, disk tagged and released.

Disk Tag Application

Coho adults were Petersen disk tagged in a wooden tray (10 cm x 10 cm x 100 cm) constructed with a flexible plastic bottom and a meter stick recessed in one side. The tags consisted of two 2.2 cm diameter laminated cellulose acetate disks and one 0.7 cm diameter transparent plastic buffer disk threaded through centrally punched holes onto a 7.7 cm long nickel pin. The pin was inserted with pliers through the musculature and pterygiophore bones approximately 1.2 cm below the anterior portion of the dorsal fin insertion. The disk tags, arranged with one on each side of the fish and with a buffer disk on the pin head side, were secured by twisting the pin into a double knot. One disk per pair was numbered with a unique code. Initially, green and blue disk tags were used to reduce colour contrast, thereby minimizing recovery and predation biases; however, yellow disk tags and baffles were used in the latter part of the study.

Each disk tagged fish received a secondary mark to allow the assessment of disk tag loss. A 0.7 cm diameter hole was punched through the operculum using a single hole paper punch. Care was taken to avoid gill tissue damage.

Date and location (reach) of capture, disk tag number, nose-fork (NF) length (to the nearest 0.1 cm), sex and adipose fin status were recorded for each fish released with a disk tag. Release condition was recorded as 1 (swam away vigorously), 2 (swam away sluggishly) or 3 (required ventilation). Recovered disk tagged carcasses were enumerated and sampled (described below) to assess handling mortality.

Stream Surveys

Weekly stream surveys were conducted from November 4, 1987 to January 19, 1988. Complete surveys, conducted by a three or four person crew walking in an upstream direction, required up to two days.

Live adults were counted and carcasses were recorded by date, reach, sex (confirmed by abdominal incision) and mark type (disk tag, secondary mark or AFC). Each marked carcass and every tenth unmarked carcass was sampled. All carcasses were then cut in two with a machete and returned to the river. Sample data, recorded by date and reach, included postorbital-hypural plate (POH) length (to the nearest 0.1 cm), sex, female spawning success (0%, 50% or 100% spawned), adipose fin and carcass condition, and scale samples. For AFC coho, the head was removed posterior to the eye orbit for later CWT identification. Adipose fin condition was recorded as unclipped or as complete (flush with dorsal surface), partial (nub present) or questionable (appeared clipped but fungus or decomposition obscured area). The condition of AFC carcasses was recorded as fresh (gills red or mottled), moderately fresh (gills white, body firm), moderately rotten (body intact, flesh soft) or rotten (skin and bones), and the absence of one or both eyes was noted.

Escapement Estimation

Total Escapement: The 1987-88 escapement of Salmon River coho adults was calculated from the mark-recapture data using the Petersen form-

ula (Chapman modification) (Ricker 1975). Total escapement was the sum of escapement by sex:

1) Estimated Salmon River coho escapement (N_t):

$$N_t = N_m + N_f$$

where:

N_m = estimated escapement of adult males;

$$= \frac{(M_m + 1)(C_m + 1)}{(R_m + 1)}$$

N_f = estimated escapement of females, analogous to above.

2) Estimated 95% confidence limits of N_t:

$$N_t \pm 1.96\sqrt{V_t}$$

where:

N_t = total escapement estimate;
V_t = variance of the escapement estimate;
$= V_m + V_f$
V_m = variance of the adult male escapement estimate;

$$= \frac{(N_m^2)\ (C_m - R_m)}{(C_m + 1)\ (R_m + 2)}$$

N_m = adult male escapement estimate;
C_m = number of adult male carcasses examined for disk tags;
R_m = number of disk tagged/secondary marked adult males recovered;
V_f = variance of female escapement estimate, analogous to above.

Sex Identification Correction: The disk tag application data were corrected for sex identification error. Error occurred because the development of sexually dimorphic traits was often not advanced and internal examinations could not be made. Correction of recovery data was unnecessary because all carcasses were incised and examined internally. Sex identification error was corrected as described by Staley (MS 1989):

3) Estimated true number of males released with disk tags and secondary marks (M_m):

$$M_m = \frac{M_m^* - (M_t R_{m,f})/R_f}{1 - (R_{m,f}/R_f) - (R_{f,m}/R_m)}$$

where:

M_m^* = field estimate of number of males released with disk tags and secondary marks;
M_t = total number of coho adults released with disk tags and secondary marks;
$R_{m,f}$ = number of females recovered with disk tags which were released as males;
$R_{f,m}$ = number of males recovered with disk tags which were released as females;
R_f = number of females recovered with disk tags;
R_m = number of males recovered with disk tags.

4) Estimated true number of females released with disk tags and secondary marks (M_f):

$$M_f = M_t - M_m$$

Adipose Fin Clipped Escapement: The estimated AFC escapement was the product of the AFC incidence in the carcass recovery sample, the largest

of the two available samples, and the mark-recapture escapement estimate. Ninety-five percent confidence limits were calculated from the respective upper and lower confidence limits of the AFC incidence and the escapement estimate. For example, the upper 95% confidence limit of the AFC escapement estimate was the product of the upper limit of the AFC incidence and the upper limit of the total mark-recapture estimate. The mathematical relationships are reported below (Cochran 1977):

5) Estimated AFC escapement (N_a):

$$N_a = p(N_t)$$

6) Estimated 95% confidence limits for p:

$$p \pm 1.96\ (se + fpc)$$

where:

p = proportion of the sample with an AFC;

se = standard error;

$= (1-f)pq/(n-1)$

fpc = finite population correction;

$= \frac{1}{2n}$

n = sample size;

q = 1-p

$f = \frac{n}{N_t}$

Escapement by CWT Code: Escapement by CWT code and long term CWT loss were calculated by applying the CWT composition in the carcass recovery sample to the estimated return of AFC coho adults. Estimated CWT loss was an average for the three codes.

RESULTS

JUVENILE PROGRAM

Fish Capture

Coho smolt catch totaled 10,081 in 1986, 2,667 in the Salmon River and 7,414 in Coghlan Creek (Appendix 1). The smolt migration began before trap installation on April 17 and continued through early June. The 50% migration occurred on May 10 and May 12 in the Salmon River and Coghlan Creek, respectively, while the peak catches occurred on May 12 and May 17 (Figures 2 and 3). Because the traps were inoperable for three days in May, the true size and timing of the 1986 smolt emigration were unknown.

Coded Wire Tagging

AFC and CWT releases totaled 10,063 coho smolts in 1986 (Table 1; Appendix 2). When adjusted for short term (24-hour) CWT loss and mortality, the number released with CWTs and identifiable AFCs was 10,059.

Short term CWT loss averaged 0.1% (range of 0% to 2.2%). The incidence of poor AFCs and delayed mortality both averaged less than 0.1%. The incidence of disease, damage or structural anomalies averaged 2.8% (Appendix 3). The most prevalent condition was an infestation of flukes of the genus **Neascus**, commonly termed blackspot disease. This condition was most prevalent in the Salmon River where 5.5% of the coho smolts were affected. No smolts with naturally missing adipose fins were noted.

Coho Smolt Age and Size

Coho smolts emigrated from the Salmon River system primarily as yearling or age 2 smolts (99.6%), with age

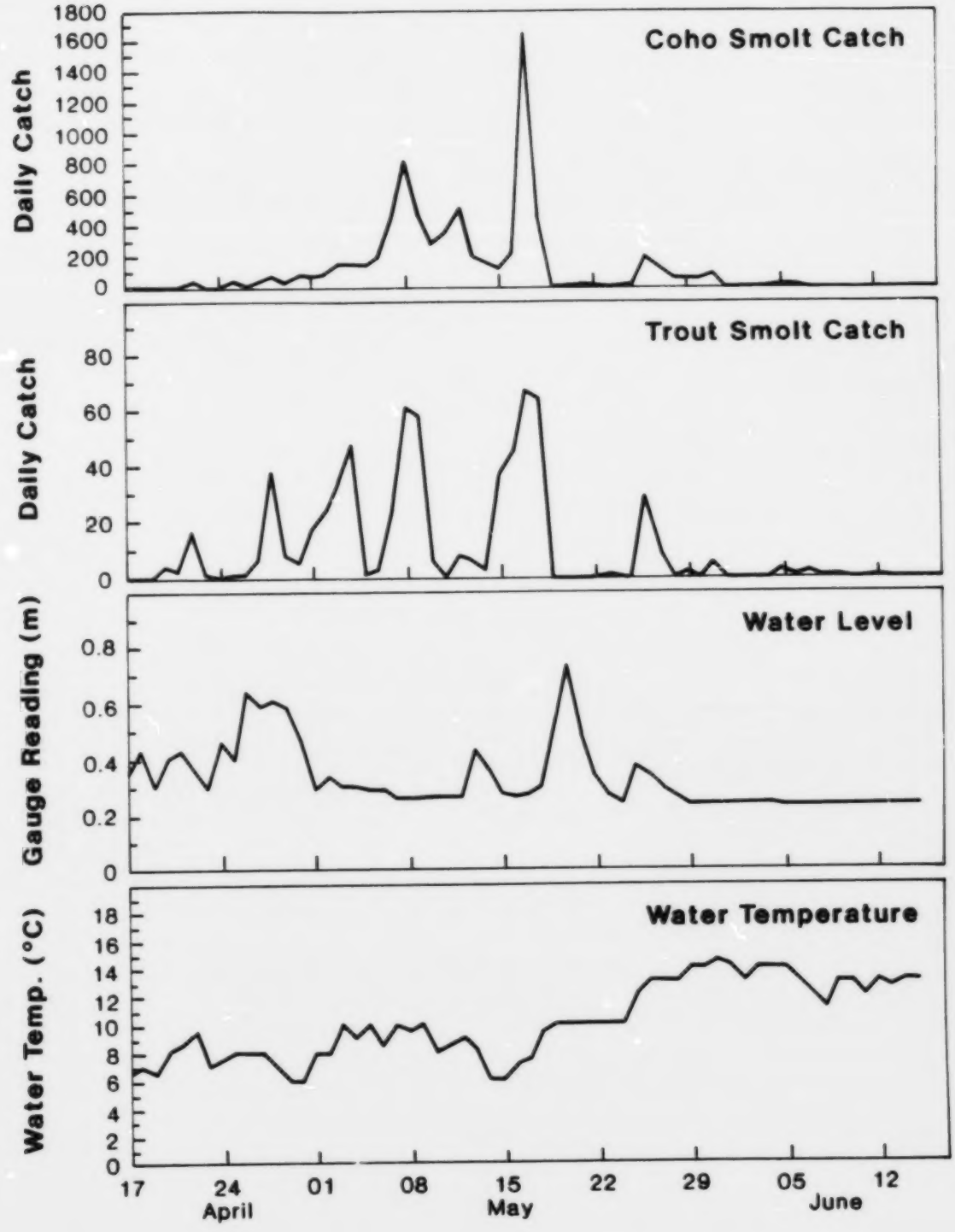

Figure 2 Daily catch of Coghlan Creek coho and trout smolts in relation to water level and temperature, 1986.

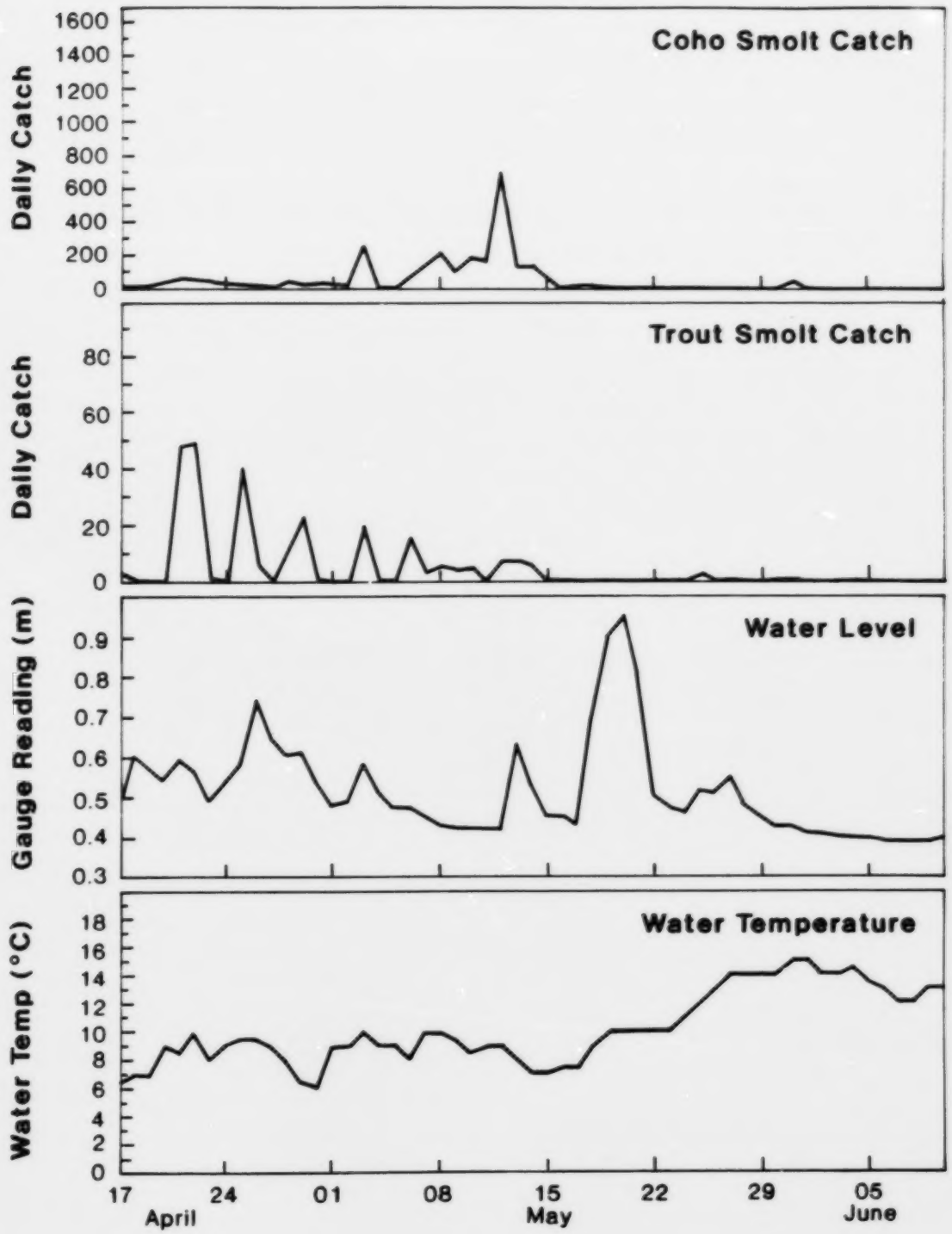

Figure 3 Daily catch of Salmon River coho and trout smolts in relation to water level and temperature, 1986

Table 1. Coho smolt coded wire tagging results, by location and code, in the Salmon River system, 1986.

Capture location	CWT Code	Number processed	Estimated post-tagging mortality	CWT lost	Poor AFC	Number released with AFCs and CWTs
Salmon River	02 38 38	893	0	0	0	893
	02 38 39	883	0	0	0	883
	02 38 40	887	0	0	0	887
	Total	2,663	0	0	0	2,663
Coghlan Creek	02 38 38	2,692	1	1	0	2,690
	02 38 39	2,606	0	1	0	2,605
	02 38 40	2,102	0	1	0	2,101
	Total	7,400	1	3	0	7,396
Total	02 38 38	3,585	1	1	0	3,583
	02 38 39	3,489	0	1	0	3,488
	02 38 40	2,989	0	1	0	2,988
	Total	10,063	1	3	0	10,059

Table 2. Disk tag application, carcass examination and mark recovery by sex of Salmon River coho adults, 1987-88.

	Disk tags applied [a]	Carcasses examined [b]	Marked carcasses recovered [b]				
			Disk tag and secondary mark	Secondary mark only	Disk tag only	Total	Percent recovered
Male	834	1,445	178	0	0	178	21.3%
Female	488	1,857	170	4	0	174	35.7%
Adipose present	1,277	3,190	328	4	0	332	26.0%
Adipose absent	45	112	20	0	0	20	44.4%
Total	1,322	3,302	348	4	0	352	26.6%

[a] Adjusted for sex identification error.
[b] Jacks excluded.

3 smolts forming the remainder of the run. Smolt size averaged 102.1 mm and 10.3 g in the Salmon River and 97.6 mm and 9.0 g in Coghlan Creek (Appendix 4). Weighted mean smolt size was 98.8 mm and 9.3 g. Size increased to a peak in early to mid May and decreased through the remainder of the run.

ADULT PROGRAM

Mark Recapture

Disk Tag Application: One thousand, three hundred and twenty-two coho adults were released with disk tags and secondary marks from October 28 to December 18, 1987 (Table 2; Appendix 5). Of that total, 45 were missing the adipose fin. Condition at release was good, except for 70 (5.3%) which required ventilation (Table 3). No difference ($p > 0.05$; chi-square) was noted in the proportion of this group recovered on the spawning grounds.

An estimated 11.8% of the males and 14.1% of the females were misidentified at the time of tagging (Appendix 6). When adjusted for sex identification error, an estimated 834 (63.1%) males and 488 (36.9%) females were released with disk tags and secondary marks.

Census Sample: Spawning ground recoveries totaled 3,302 coho adults and 81 coho jacks from November 4, 1987 to January 19, 1988 (Table 2; Appendix 7). Of the adults, 1,445 (43.8%) were male and 1,857 (56.2%) were female, 352 (10.7%) had disk tags and/or secondary marks and 112 (3.4%) had an AFC. Nine (11.1%) of the jacks had an AFC. Four of the coho adults were recovered with a secondary mark only. None were recovered with a disk tag only. No difference was noted in disk tag loss among females (2.3%) and males (0.0%) ($p > 0.05$; chi-square).

Sample Selectivity by Period: Temporal bias in the application sample was examined by comparing between periods the mark incidence in the census sample (Table 4). No significant difference ($p > 0.05$; chi-square) was noted between periods or sexes.

Temporal bias in the census sample was examined by stratifying the application sample by period and comparing proportions recovered (Table 5). No significant difference ($p > 0.05$) was noted between periods.

Sample Selectivity by Reach: Spatial bias in the application sample was examined by comparing between reaches the mark incidence in the census sample (Table 6). Mark incidence ranged from 0.0% to 29.0%, with significantly higher ($p < 0.05$) incidences in reaches S1 (29.0%) and S2 (21.6%).

Spatial bias in the census sample was examined by stratifying the application sample by reach and comparing proportions recovered (Table 7). No difference ($p > 0.05$) was noted.

Sample Selectivity by Length: Size related bias in the application sample was assessed by comparing the continuous length frequency distributions of marked and unmarked spawning ground recoveries. No significant difference was noted in males ($D_{max} = 0.06$; $D_{0.05} = 0.13$) (Kolmogorov-Smirnov two sample test; Sokal and Rohlf 1981) or females ($D_{max} = 0.10$; $D_{0.05} = 0.13$). The application sample, therefore, was unbiased with respect to size.

Recovery bias was assessed by partitioning the application sample into recovered and nonrecovered components and comparing the continuous NF length frequency distributions of each. The distributions were significantly different for both males

Table 3. Disk tag application and recovery of Salmon River coho salmon, by release condition, 1987-88.

Release condition	Disk tags applied [a]	Disk tags recovered [b]	Percent recovered
Fish swam away without assistance	1,251	324	25.9%
Fish required ventilation	70	23	32.9%
Total	1,322	352	26.6%

[a] Release condition unavailable for one male.
[b] Release condition unavailable for four females recovered without disk tags and for 1 male at release.

Table 4. Incidence of disk tags or secondary marks in coho adults recovered on the spawning grounds, by period and sex, in the Salmon River system, 1987-88.

Recovery period	Recovered with disk tag or secondary mark			Total			Percent with disk tag or secondary mark		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
04-Nov to 28-Nov	92	81	173	604	600	1,204	15.2%	13.5%	14.4%
29-Nov to 25-Dec	58	63	121	599	872	1,471	9.7%	7.2%	8.2%
26-Dec to 20-Jan	28	30	58	242	385	627	11.6%	7.8%	9.3%
Total	178	174	352	1,445	1,857	3,302	12.3%	9.4%	10.7%

Table 5. Proportion of the disk tag application sample recovered on the spawning grounds, by application period, in the Salmon River system, 1987-88.

Application period	Disk tags applied	Disk tags recovered [a]	Percent recovered
27-Oct to 06-Nov	327	98	30.0%
07-Nov to 20-Nov	550	154	28.0%
21-Nov to 04-Dec	340	79	23.2%
05-Dec to 18-Dec	105	17	16.2%
Total	1,322	348	26.3%

[b] Stratified data do not include four with secondary mark only.

Table 6. Incidence of disk tags and secondary marks, by reach, in the Salmon River system spawning ground recovery sample, 1987-88.

		Carcasses examined		Carcasses recovered with disk tags or secondary marks	
Location	Reach	Number	Percent of total	Number	Mark Incidence
Salmon River	S1	880	26.7%	255	29.0%
	S2	139	4.2%	30	21.6%
	S3	698	21.1%	26	3.7%
	S4	131	4.0%	1	0.8%
	S5	31	0.9%	1	3.2%
Coghlan Creek	C1	972	29.4%	29	3.0%
	C2	156	4.7%	5	3.2%
	C3	146	4.4%	5	3.4%
	C4	87	2.6%	0	0.0%
	C5	62	1.9%	0	0.0%
Total	-	3,302	-	352	-

Table 7. Proportion of the disk tag application sample recovered on the spawning grounds, by application reach, in the Salmon River system, 1987-88.

Location	Reach	Disk tags applied		Disk tags recovered	
		Number	Percent of total	Number[a]	Percent recovered
Salmon River	B1[b]	32	2.4%	1	3.1%
	S1	1,071	81.0%	268	25.0%
	S2	43	3.3%	19	44.2%
	S3	119	9.0%	42	35.3%
Coghlan Creek	C1	57	4.3%	18	31.6%
Total	-	1,322	-	348	26.3%

[a] Does not include four recovered with secondary mark only.
[b] Downstream from S1 (Fig. 1). Location abandoned after initial application attempts.

Table 8. Disk tag application and recovery of Salmon River coho adults, by nose-fork length, 1987-88.

Nose-fork length (cm)	Disk tags applied [a]	Carcasses recovered with disk tags [b]	Percent recovered
31-40	47	2	4.3%
41-50	328	59	18.0%
51-60	789	223	28.3%
61-70	151	61	40.4%
71-80	5	2	40.0%
Total	1,320	347	26.3%

[a] Two coho adults were not measured at release.
[b] Four recoveries had lost the disk tag; one recovery was not measured at release.

(D_{max} = 0.22; $D_{0.05}$ = 0.12) and females (D_{max} = 0.18; $D_{0.05}$ = 0.13). The application sample, therefore, was biased with respect to size. The bias was more obvious when recovery proportions were calculated from disk tag application and recovery data stratified by length (Table 8). The proportion recovered increased with NF length.

Sample Selectivity by Sex: Sex related bias in the application sample was assessed by comparing the sex ratio of the marked and unmarked spawning ground recoveries (Table 9). The application sample was biased ($p < 0.05$; chi square) toward males.

Recovery bias was assessed by partitioning the application sample into recovered and nonrecovered components and comparing the sex ratio in each (Table 9). The recovery sample was biased ($p < 0.05$) toward females.

Spawning Success: Spawning success, estimated from internal examination of female spawning ground recoveries, was estimated at 91.9% (Appendix 8). Spawning success of marked females (86.7%) was significantly lower ($p < 0.05$; difference in proportions test) than in unmarked females (98.5%).

Estimation of Spawner Population

Total Escapement: The 1987-88 escapement of Salmon River coho adults calculated from mark-recapture data (Table 2), was 11,947. Upper and lower 95% confidence limits were 13,124 and 10,770, respectively. The escapement of female and male coho adults was 5,197 and 6,750, respectively.

Adipose Fin Clipped Adults: Based on the coho adult AFC incidence in the census sample (3.4%; Table 2), the 1987-88 escapement of AFC adults was 405, with upper and lower confidence limits of 480 and 336, respectively. Of that total, an estimated 319 returned with CWTs (Table 10) and 87 (21.6%) had lost the CWT (Appendix 9). CWT loss was not influenced by carcass decomposition or predators (Appendix 10).

Age/Length/Sex Composition

The age and length composition of 585 coho salmon recovered on the spawning grounds is summarized by sex in Appendix 11. All sampled females were age 3_2. Ninety-six percent of the males were age 3_2, with the remainder (3.6%) age 2_2.

POH length of adult males and females averaged 42.0 cm and 45.5 cm, respectively. POH length of coho jacks averaged 26.1 cm. NF length of adult males and females, measured during disk tag application, averaged 51.8 cm and 55.7 cm, respectively.

Females comprised 36.9% of the application sample, 56.2% of the census sample (Table 2) and 43.5% of the Petersen population estimate.

DISCUSSION

ADULT CAPTURE TECHNIQUE

In the development of field procedures for the adult component of the Salmon River study, a number of capture techniques were considered. Our main requirement was to representatively distribute tags through the population, both spatially and temporally, while satisfying the basic requirements underlying the mark-recapture technique (Ricker 1975). A previous study (Grant MS 1987) had applied disk tags at a temporary enumeration fence constructed at the

Table 9. Sex composition of disk tag application and spawning ground recovery samples of Salmon River system coho adults, 1987-88.

	Application sample[a]			Spawning ground recovery sample		
	Recovered	Not Recovered	Total	Disk tag or secondary mark	Unmarked	Total
Male	50.6%	67.6%	63.1%	50.6%	42.9%	43.8%
Female	49.4%	32.4%	36.9%	49.4%	57.1%	56.2%
Sample size	352	970	1,322	352	2,950	3,302

[a] Corrected for sex identification error.

Table 10. Summary of smolt release, adult escapement and survival to adult escapement of 1984 brood Salmon River coho salmon.

CWT Code	Number released[a]	Spawning ground recoveries		Estimated adipose clipped escapement	Percent survival to escapement
		Number	%		
02 38 38	2,811	24	23.5%	97	3.5%
02 38 39	2,736	28	27.5%	113	4.1%
02 38 40	2,344	27	26.5%	109	4.7%
CWT lost	-	1	1.0%	-	-
Total	7,891	80	78.4%	319	4.0%
No CWT	-	22	21.6%	87	-

[a] Adjusted for long term CWT loss.

Table 11. Summary of results of statistical tests for bias in the 1987 Salmon River escapement estimation study.

Test	Application sample	Recovery Sample
Time Period	No Bias	No Bias
Location	Bias toward reaches S1 and S2	No Bias
Fish size	No Bias	Bias toward larger fish
Fish sex	Bias toward males	Bias toward females

river mouth. This technique was rejected because a significant but unknown proportion of those tags were applied to coho adults originating from other streams. A number were subsequently recovered in Indian food fishery nets on the Fraser River and in other Fraser River tributaries. The use of an enumeration fence further upstream was rejected due to cost and to high flows associated with the heavy rainfalls common to this area during the study period. Angling and the use of nets were rejected because of the extensive overhanging vegetation and instream debris. Electroshocking was selected as the most favorable technique.

To be a useful capture technique for mark-recapture experiments, capture and marking should not affect the subsequent vulnerability of the fish to recovery. Electrical current is known to cause stress in fish (Wydoski and Wedemeyer 1976) and, indeed, stress was noted in the present study. The spawning success of marked Salmon River females was almost 12 percentage points lower than in unmarked females; however, although capture stress was apparently associated with reduced spawning success, it was uncertain whether catchability was also affected. The mean time between capture and recovery (19 days; Appendix 6) was slightly higher than that reported in a similar study using an enumeration fence (Schubert and Fleming 1989) and was above the upper limit of the range in stream residency time reported in the literature (e.g. Crone and Bond 1976; Flint and Zillges 1980). This observation: a) was opposite to that expected if capture had resulted in high stress and associated mortality; b) indicated that post tagging survival was similar to that observed under less stressful capture techniques; and c) suggested that, if present, estimation bias resulting from capture stress was likely minor. However, in view of the potential impact of capture stress on study results, this factor should be evaluated in future studies.

SAMPLING SELECTIVITY

An evaluation of the 1987 Salmon River coho adult escapement estimation study identified biases in both the disk tag application and recovery samples (Table 11). The application sample was unbiased with respect to application period and fish size, and biased with respect to application location and fish sex. The recovery sample was unbiased with respect to

application period and location but biased with respect to fish size and sex.

The most serious study bias was the nonrandom distribution of disk tags among the spawner population. This bias resulted from the assumption that spawners destined for upstream areas would be equally vulnerable to capture efforts in the lower part of the river (Reach S1). The recovery sample, however, showed very little dispersion of disk tagged adults beyond reaches S1 and S2 (Table 6). The distribution of disk tagged fish, therefore, clearly was not random. While ideally both the application and recovery efforts should be randomly distributed over the population, Robson (1969) showed that valid estimates could be produced if only one of the samples was random. In the Salmon River study, estimation error may have been avoided because bias was not noted in the recovery sample. To investigate this assumption, we stratified the data by reach and estimated the escapement using Schaefer's modification of the Petersen method for use with stratified populations (Ricker 1975). The resulting estimate was within 4% of the Petersen estimate and well within it's 95% confidence range. We concluded, therefore, that the assumption was valid. Regardless, future studies should attempt to distribute application effort in proportion to the expected spawner distribution.

A positive size bias was noted in the recovery sample. Similar biases associated with spawning ground surveys have been reported elsewhere (Schubert et al. 1985) and would not normally be a concern because the application sample was unbiased with respect to size. Because adult coho were captured with an electroshocker, however, application sample bias may have been masked by a similar bias in the recovery sample. Other studies have demonstrated that larger fish are more sensitive to electric current (Sullivan 1956; Novotny and Priegel 1974). While it was not possible to determine if such a bias was present in the Salmon River study, two factors suggest that any impact on the escapement estimate was likely to have been minor. First, if present, a large size bias in the application sample would have prevented the detection of a similar bias in the recovery sample. Because a recovery bias was noted, application bias was probably small. Second, results from other studies show that, even when size bias was large, the impact on escapement estimates was generally minor (Ricker 1975).

Sex biases were noted in both the application and recovery samples, the former toward males and the latter toward females (Table 11). Because the biases were in opposite directions, they were corrected by calculating escapement by sex.

In summary, it was unlikely that sample selectivity resulted in a biased escapement estimate in the 1987 Salmon River study. Junge (1963) demonstrated that selectivity can exist in both application and recovery samples without introducing population estimation biases if the sources of selectivity are independent, and if the source of selectivity in the recovery sample is independent of mark status. Both conditions were met in the Salmon River study.

SUMMARY

1. The Salmon River (Langley) coho stock is one of a group of British Columbia stocks being closely monitored to evaluate responses to management actions by measuring, with known precision, annual escapement, marine survival, harvest distribution and exploitation rate.

2. Coded wire tags (CWT) were applied to emigrant smolts from April 23 to June 17, 1986. The smolts were captured at fence traps in the Salmon River and in Coghlan Creek, the principal tributary. Tagged smolts were transported and released below the pumphouse at the river mouth.

3. A total of 10,059 coho smolts were released with CWTs and adipose fin clips. Size averaged 98.8 mm nose-fork length and 9.3 g.

4. Adult spawners were enumerated by a mark-recapture study between October 28, 1987 and January 19, 1988. Coho adults were captured using an electroshocker and marked with Petersen disk tags and an operculum punch. The escapement was censused by the recovery of carcasses following spawning.

5. The 1987 adult coho escapement was estimated from a disk tag application sample of 1,322, a census sample of 3,302 and a recovery 352 carcasses with disk tags or secondary marks. The estimated escapement was 11,947, of which 5,197 were female, 6,750 were male and 405 had adipose fin clips.

6. The estimated return to the spawning grounds of codes 02 38 38, 02 38 39 and 02 38 40 were 97, 113 and 109, respectively. Survival from smolt release to spawning ground recovery was 4.0%. CWT loss averaged 21.6%.

7. The age composition of the adult coho escapement, measured from the census sample, was entirely age 3_2. Adult POH length averaged 42.0 cm for males and 45.5 cm for females.

8. Biases were identified in both the application and recovery samples. These sampling biases did not bias the final population estimate.

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Appendices

Appendix 1a. Daily fence trap catches in the Salmon River, 1986.

Date	Water Temp. (C) a	Water level (m) a	Coho smolt	Trout		Lamprey		Sculpin	Stickle-back	Cray-fish	Sucker
				Smolt	Presmolt	Pacific	Other				
17-Apr	6.5	0.50	6	3	0	1	2	0	0	0	0
18-Apr	7.0	0.60	3	0	0	0	0	0	0	0	1
19-Apr	7.0	0.57	14	0	0	1	0	0	3	0	0
20-Apr	9.0	0.54	33	0	0	0	0	0	0	0	0
21-Apr	8.5	0.59	61	48	0	0	1	0	0	0	2
22-Apr	10.0	0.56	49	49	0	1	3	0	0	1	0
23-Apr	8.0	0.49	30	1	0	0	0	0	0	0	0
24-Apr	9.0	0.53	27	0	0	0	2	0	0	0	0
25-Apr	9.5	0.58	16	40	0	0	0	0	0	0	0
26-Apr	9.5	0.74	13	6	0	0	0	0	0	0	0
27-Apr	9.0	0.64	2	0	0	1	2	0	0	0	0
28-Apr	8.0	0.60	44	12	0	0	0	0	0	0	0
29-Apr	6.5	0.61	17	23	0	0	3	0	1	0	1
30-Apr	6.0	0.53	28	1	0	0	0	0	0	0	0
01-May	9.0	0.48	11	0	0	0	15	0	0	0	0
02-May	9.0	0.49	13	1	0	0	8	0	0	0	0
03-May	10.0	0.58	260	20	0	0	0	0	0	0	0
04-May	9.0	0.51	2	0	0	0	1	0	0	0	0
05-May	9.0	0.47	0	0	0	0	0	0	0	0	0
06-May	8.0	0.47	78	15	0	0	0	0	0	0	0
07-May	10.0	0.45	148	3	0	0	0	0	1	0	0
08-May	10.0	0.43	218	6	0	0	1	0	2	0	0
09-May	9.5	0.42	105	4	0	0	3	0	0	0	0
10-May	8.5	0.42	197	6	0	0	2	0	0	0	1
11-May	9.0	0.42	162	0	0	0	0	0	0	1	0
12-May	9.0	0.42	695	8	0	0	0	0	0	0	0
13-May	8.0	0.63	130	8	0	0	1	0	0	0	0
14-May	7.0	0.52	136	6	0	0	0	0	0	0	0
15-May	7.0	0.45	57	0	0	0	0	0	2	3	0
16-May	7.5	0.45	2	0	0	0	0	0	0	0	0
17-May	7.5	0.43	25	0	0	0	3	0	0	0	0
18-May	9.0	0.70	20	0	0	0	3	0	3	0	0
19-May b	10.0	0.90	0	0	0	0	0	0	0	0	0
20-May b	10.0	0.95	0	0	0	0	0	0	0	0	0
21-May b	10.0	0.80	0	0	0	0	0	0	0	0	0
22-May	10.0	0.50	0	0	0	0	0	0	1	0	0
23-May	10.0	0.47	0	0	0	0	0	0	0	0	0
24-May	11.0	0.46	0	0	0	0	0	0	0	0	0
25-May	12.0	0.52	0	3	0	0	0	0	0	0	0
26-May	13.0	0.51	0	0	0	0	0	0	1	0	0
27-May	14.0	0.55	0	1	0	0	0	0	0	8	0
28-May	14.0	0.48	4	0	0	2	0	0	0	1	0
29-May	14.0	0.45	1	0	0	0	0	0	0	0	0
30-May	14.0	0.43	0	1	0	0	0	0	0	0	0
31-May	15.0	0.43	56	1	0	0	0	0	0	0	0
01-Jun	15.0	0.41	4	0	0	0	1	0	0	0	0
02-Jun	14.0	0.41	0	0	0	0	0	0	0	0	0
03-Jun	14.0	0.40	0	0	0	0	0	0	0	0	0
04-Jun	14.5	0.40	0	1	0	0	0	0	0	0	0
05-Jun	13.5	0.40	0	0	0	0	0	0	2	0	0

Appendix 1a. Daily fence trap catches in the Salmon River, 1986.

Date	Water Temp. (C) a	Water level (m) a	Coho smolt	Trout		Lamprey		Sculpin	Stickle-back	Cray-fish	Sucker
				Smolt	Presmolt	Pacific	Other				
06-Jun	13.0	0.39	0	0	0	0	2	0	0	0	0
07-Jun	12.0	0.39	0	0	0	0	0	0	0	0	0
08-Jun	12.0	0.39	0	0	0	0	0	0	0	0	0
09-Jun	13.0	0.39	0	0	0	0	0	0	0	0	0
10-Jun	13.0	0.40	0	0	0	0	0	0	0	0	0
Total	-	-	2,667	267	0	6	53	0	16	14	5

a. Recorded at 9:30 AM.
b. Fence out due to high water.

Appendix 1b. Daily fence trap catches in Coghlan Creek, 1986.

Date	Water temp. (C) a	Water level (m) a	Coho smolt	Trout		Lamprey		Sculpin	Stickle-back	Cray-fish	Sucker
				Smolt	Presmolt	Pacific	Other				
17-Apr	6.5	0.34	0	0	0	0	0	0	0	0	0
18-Apr	7.0	0.43	1	0	0	0	0	0	0	0	0
19-Apr	6.5	0.30	0	0	0	0	0	0	0	0	1
20-Apr	8.0	0.40	1	4	0	0	0	0	0	0	0
21-Apr	8.5	0.43	2	2	0	0	0	0	0	0	0
22-Apr	9.5	0.36	45	17	0	0	1	0	0	0	0
23-Apr	7.0	0.29	1	1	0	0	0	0	0	0	0
24-Apr b	7.5	0.46	0	0	0	0	0	0	0	0	0
25-Apr	8.0	0.40	45	1	0	0	0	0	4	0	0
26-Apr	8.0	0.64	8	1	0	0	0	0	0	0	0
27-Apr	8.0	0.59	35	7	0	1	0	0	0	0	0
28-Apr	7.0	0.61	72	38	0	0	2	0	0	0	0
29-Apr	6.0	0.58	28	8	0	0	0	0	0	0	0
30-Apr	6.0	0.46	77	5	0	0	0	0	1	0	0
01-May	8.0	0.30	68	17	0	0	3	0	0	0	2
02-May	8.0	0.34	90	24	0	0	0	0	0	0	0
03-May	10.0	0.30	151	34	0	0	0	0	0	0	0
04-May	9.0	0.30	144	47	0	0	0	0	0	2	0
05-May	10.0	0.29	138	1	0	0	0	0	0	0	1
06-May	8.5	0.29	206	3	1	0	1	0	0	0	0
07-May	10.0	0.26	455	23	0	0	0	0	3	1	4
08-May	9.5	0.26	804	61	2	0	0	0	0	0	0
09-May	10.0	0.26	472	58	6	0	0	0	0	4	0
10-May	8.0	0.27	273	6	0	0	0	0	1	0	0
11-May	8.5	0.27	354	0	0	0	0	0	0	0	0
12-May	9.0	0.27	507	8	0	0	3	0	0	0	0
13-May	8.0	0.43	198	6	0	0	0	0	0	0	0
14-May	6.0	0.36	160	3	0	0	6	0	0	0	0
15-May	6.0	0.27	110	37	4	1	0	0	0	1	0
16-May	7.0	0.26	221	45	1	0	0	0	0	0	0
17-May	7.5	0.27	1,640	67	1	0	1	0	0	3	0
18-May	9.5	0.30	453	64	0	0	7	0	0	3	0
19-May b	10.0	0.52	0	0	0	0	0	0	0	0	0
20-May b	10.0	0.73	0	0	0	0	0	0	0	0	0
21-May	10.0	0.49	12	0	0	0	1	0	8	0	0
22-May	10.0	0.34	3	0	0	0	0	0	1	0	0
23-May	10.0	0.27	0	1	0	0	0	0	0	0	0
24-May	10.0	0.24	0	0	0	0	2	0	4	0	0
25-May	12.0	0.37	18	0	0	0	0	0	0	0	0
26-May	13.0	0.34	190	29	0	0	0	0	0	0	0
27-May	13.0	0.30	114	10	0	0	0	0	0	0	0
28-May	13.0	0.27	53	1	0	0	0	0	0	0	0
29-May	14.0	0.24	57	3	0	0	0	0	0	0	0
30-May	14.0	0.24	56	0	0	0	0	0	0	0	0
31-May	14.5	0.24	93	6	0	0	0	0	0	0	0
01-Jun	14.0	0.24	0	0	0	0	0	0	0	0	0
02-Jun	13.0	0.24	2	0	0	0	0	1	0	0	0
03-Jun	14.0	0.24	5	0	0	0	0	2	0	0	0
04-Jun	14.0	0.24	6	0	0	0	0	0	0	0	0
05-Jun	14.0	0.23	21	3	0	0	0	0	0	0	0

Appendix 1b. Daily fence trap catches in Coghlan Creek, 1986.

Date	Water temp. (C) a	Water level (m) a	Coho smolt	Trout		Lamprey		Sculpin	Stickle-back	Cray-fish	Sucker
				Smolt	Presmolt	Pacific	Other				
06-Jun	13.0	0.23	20	1	0	0	0	0	0	0	0
07-Jun	12.0	0.23	4	3	0	0	0	0	0	0	0
08-Jun	11.0	0.23	0	1	0	0	1	0	0	0	0
09-Jun	13.0	0.23	1	1	0	0	0	0	0	0	0
10-Jun	13.0	0.23	0	0	0	0	0	0	0	0	0
11-Jun	12.0	0.23	0	0	0	0	0	0	0	1	0
12-Jun	13.0	0.23	0	1	0	0	0	0	2	0	0
13-Jun	12.5	0.23	0	0	0	0	0	0	0	0	0
14-Jun	13.0	0.23	0	0	0	1	1	0	0	0	0
15-Jun	13.0	0.23	0	0	0	0	0	0	0	2	0
16-Jun	-	-	0	0	0	0	0	0	0	0	0
17-Jun	-	-	0	0	0	0	0	0	0	0	0
Total	-	-	7,414	648	15	3	29	3	24	17	8

a. Recorded at 10:00 AM.
b. Fence out due to high water.

Appendix 2a. 1986 Salmon River coded wire tagging results, by code.

CWT Code	Tagging date	Pre-tagging mort-ality	Total number marked	24 hour CWT rejection (%) a	Post tagging mortality		AFC but no CWT	Total released with adipose clips and CWT b
					Immediate	24-hour a		
02 38 38	23-Apr	0	202	0.00	0	0	0	202
	30-Apr	0	37	0.00	0	0	0	37
	05-May	0	137	2.19	0	0	0	137
	08-May	0	100	1.00	0	0	0	100
	09-May	1	24	0.00	0	0	0	24
	15-May	3	393	0.00	0	0	0	393
	Total	4	893	0.45	0	0	0	893
02 38 39	30-Apr	0	40	0.00	0	0	0	40
	05-May	0	82	0.00	0	0	0	82
	08-May	1	180	0.00	0	0	0	180
	09-May	0	20	0.00	0	0	0	20
	15-May	3	469	0.00	0	0	0	469
	19-May	0	23	0.00	0	0	0	23
	06-Jun	0	69	0.00	0	0	0	69
	Total	4	883	0.00	0	0	0	883
02 38 40	30-Apr	0	55	0.00	0	0	0	55
	05-May	0	85	0.00	0	0	0	85
	08-May	2	160	0.63	0	0	0	160
	09-May	1	60	0.00	0	0	0	60
	15-May	0	506	0.00	0	0	0	506
	19-May	0	21	0.00	0	0	0	21
	Total	3	887	0.11	0	0	0	887
Total	-	11	2,663	0.19	0	0	0	2,663

a. QCD sample included all marked fish; therefore, release figures were not corrected for CWT loss.

Appendix 2b. 1986 Coghlan Creek coded wire tagging results, by code.

CWT Code	Tagging date	Pre-tagging mortality	Total number marked	24 hour CWT rejection (%) a	Post tagging mortality		AFC but no CWT a	Total released with adipose clips and CWT c
					Immediate	24-hour a		
02 38 38	23-Apr	4	46	0.00	0	0	0	46
	30-Apr	0	78	0.00	0	0	0	78
	05-May	0	164	0.61	0	1	0	163
	08-May	9	477	0.00	0	0	0	477
	09-May	1	202	0.00	0	0	0	202
	15-May	0	598	0.00	0	0	0	598
	19-May	3	914	b	0	0	1	913
	29-May	1	163	0.00	0	0	0	163
	06-Jun	0	50	0.00	0	0	0	50
	Total	18	2,692	0.04	0	1	1	2,690
02 38 39	23-Apr	1	80	0.00	0	0	0	80
	05-May	0	201	0.00	0	0	0	201
	08-May	1	572	0.52	0	0	0	572
	09-May	1	131	0.00	0	0	0	131
	15-May	1	748	0.13	0	0	0	748
	19-May	0	622	b	0	0	1	621
	29-May	0	157	0.00	0	0	0	157
	06-Jun	1	95	0.00	0	0	0	95
	Total	5	2,606	0.15	0	0	1	2,605
02 38 40	23-Apr	0	95	0.00	0	0	0	95
	05-May	0	203	0.00	0	0	0	203
	08-May	0	418	0.72	0	0	0	418
	09-May	3	137	0.00	0	0	0	137
	15-May	1	271	0.00	0	0	0	271
	19-May	0	788	b	0	0	1	787
	29-May	0	123	0.00	0	0	0	123
	06-Jun	0	67	0.00	0	0	0	67
	Total	4	2,102	0.14	0	0	1	2,101
Total	-	27	7,400	0.11	0	1	3	7,396

a. QCD sample included all marked fish; therefore, release figures were not corrected for CWT loss.

b. Released immediately due to high water; release figures adjusted by average CWT loss and delayed mortality.

c. All released smolts had acceptible AFCs.

Appendix 3. Incidence of anomalies encountered while coded wire tagging wild Salmon River coho salmon smolts, 1986.

Location	CWT Code	Number inspected	Fog eye	Neascus	Exop-thalmia	Scale loss	Fin erosion	General damage
Salmon River	02 38 38	893	7	44	2	9	2	0
	02 38 39	883	7	46	3	0	1	0
	02 38 40	887	4	57	0	12	5	0
	Total	2,663	18	147	5	21	8	0
	% Total	-	0.68	5.52	0.19	0.79	0.30	0.00
Coghlan Creek	02 38 38	2,692	5	5	3	21	4	0
	02 38 39	2,606	20	0	1	3	2	0
	02 38 40	2,102	3	4	0	7	2	1
	Total	7,400	28	9	4	31	8	1
	% Total	-	0.38	0.12	0.05	0.42	0.11	0.01

Appendix 4. Weekly mean length and weight of coho smolts in the Salmon River system, 1986.

Location	Date	Sample size	Mean length (mm)	s	Sample size	Mean weight (g)
Salmon River	24-Apr	25	82.5	11.28	29	5.9
	01-May	50	93.4	15.14	29	7.6
	06-May	50	90.8	13.36	46	6.9
	16-May	50	107.5	13.82	44	11.8
	31-May	50	96.4	9.38	50	9.3
	Mean a	225	102.1	-	198	10.3
Coghlan Creek	24-Apr	25	100.7	10.89	25	10.3
	01-May	50	101.0	13.42	27	9.4
	06-May	50	106.4	10.54	50	11.3
	16-May	50	99.0	9.84	50	9.2
	31-May	50	93.1	8.45	50	8.1
	Mean a	225	97.6	-	202	9.0

a. Weighted by sample period catch.

Appendix 5. Coho adult disk tag application results in the Salmon River System, 1987-88. a

Stream	Date	Reach b	Adipose Present			Adipose Absent			Total		
			Male	Female	Total	Male	Female	Total	Male	Female	Total
Salmon River	28-Oct	B1	1	1	2	0	0	0	1	1	2
	30-Oct	B1	10	2	12	0	0	0	10	2	12
	02-Nov	B1	15	1	16	0	0	0	15	1	16
		S1	51	22	73	0	0	0	51	22	73
	04-Nov	B1	2	0	2	0	0	0	2	0	2
		S1	27	11	38	1	1	2	28	12	40
		S2	1	4	5	0	2	2	1	6	7
		S3	17	12	29	1	1	2	18	13	31
	06-Nov	S1	40	18	58	1	1	2	41	19	60
		S2	20	9	29	4	1	5	24	10	34
		S3	32	15	47	2	1	3	34	16	50
	09-Nov	S1	49	13	62	5	4	9	54	17	71
	11-Nov	S1	121	80	201	1	2	3	122	82	204
	16-Nov	S1	79	58	137	4	5	9	83	63	146
	18-Nov	S1	72	51	123	3	3	6	75	54	129
	23-Nov	S1	79	61	140	1	1	2	80	62	142
	25-Nov	S1	24	15	39	0	0	0	24	15	39
	30-Nov	S1	15	5	20	0	0	0	15	5	20
		S2	1	0	1	0	0	0	1	0	1
		S3	20	18	38	0	0	0	20	18	38
	04-Dec	S1	26	28	54	0	0	0	26	28	54
	11-Dec	S1	28	30	58	0	0	0	28	30	58
		S2	0	1	1	0	0	0	0	1	1
	16-Dec	S1	2	2	4	0	0	0	2	2	4
	18-Dec	S1	13	18	31	0	0	0	13	18	31
	Total	B1	28	4	32	0	0	0	28	4	32
		S1	626	412	1,038	16	17	33	642	429	1,071
		S2	22	14	36	4	3	7	26	17	43
		S3	69	45	114	3	2	5	72	47	119
		Total	745	475	1,220	23	22	45	768	497	1,265
Coghlan Creek	25-Nov	C1	7	0	7	0	0	0	7	0	7
	30-Nov	C1	25	14	39	0	0	0	25	14	39
	11-Dec	C1	2	6	8	0	0	0	2	6	8
	18-Dec	C1	1	2	3	0	0	0	1	2	3
	Total	C1	35	22	57	0	0	0	35	22	57
Total	-	-	780	497	1,277	23	22	45	803	519	1,322

a. Not corrected for sex identification errors.

b. Salmon River: S1 - below Coghlan Cr.
S2 - Coghlan Cr. to 64 Ave.
S3 - 64 Ave. to 56 Ave.
S4 - 56 Ave. to 248 St.
S5 - 248 St. to 256 St.
S6 - Above 256 St.

Coghlan Creek: C1 - Salmon R. to Hwy. 1.
C2 - Hwy. 1 to 248 St.
C3 - 248 St. to 64 Ave.
C4 - 64 Ave. to 256 St.
C5 - Above 256 St.

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
28-Oct	B1	52.0	M	P	04-Nov	S1	41.2	F a	7
02-Nov	S1	58.0	F	P	13-Nov	S1	46.3	F	11
02-Nov	S1	53.0	M	P	11-Nov	S1	42.5	M	9
02-Nov	S1	50.5	M	P	11-Dec	S1	n/a	M	39
02-Nov	S1	56.5	M	P	14-Dec	S1	43.2	M	42
02-Nov	S1	62.0	M	P	20-Nov	S1	50.0	M	18
02-Nov	S1	52.5	M	P	14-Dec	S1	n/a	M	42
02-Nov	S1	62.0	F	A	11-Nov	S1	46.8	M a	9
02-Nov	S1	66.0	M	P	20-Nov	S1	47.1	M	18
02-Nov	S1	49.0	M	P	27-Nov	S2	36.2	M	25
02-Nov	S1	56.5	F	P	09-Dec	S1	43.2	F	37
02-Nov	S1	48.5	M	P	04-Nov	S1	38.2	M	2
02-Nov	S1	56.0	M	P	13-Nov	S1	40.6	M	11
02-Nov	S1	53.0	M	A	09-Nov	S1	41.9	M	7
02-Nov	S1	57.5	M	P	11-Nov	S1	44.2	M	9
02-Nov	S1	50.0	M	P	13-Nov	S1	37.2	M	11
02-Nov	S1	57.5	M	P	20-Nov	S1	46.2	M	18
04-Nov	S1	56.0	F	P	27-Nov	C2	45.1	F	23
04-Nov	S1	50.0	F	P	11-Dec	S1	40.8	F	37
04-Nov	S1	59.0	F	P	11-Dec	S1	49.6	F	37
04-Nov	S1	61.0	M	P	11-Dec	S1	45.1	M	37
04-Nov	S1	45.5	M	P	13-Nov	S1	32.7	M	9
04-Nov	S1	63.4	M	P	11-Dec	S1	47.6	M	37
04-Nov	S1	57.0	F	A	13-Nov	S1	45.2	F	9
04-Nov	S1	59.0	F	P	27-Nov	S1	48.9	M a	23
04-Nov	S2	59.5	F	P	06-Nov	S2	46.5	F	2
04-Nov	S2	63.0	F	A	06-Nov	S2	47.8	F	2
04-Nov	S2	57.5	F	P	27-Nov	S2	47.2	F	23
04-Nov	S3	55.0	M	P	13-Nov	S3	43.0	M	9
04-Nov	S3	59.0	F	P	27-Nov	S2	47.3	F	23
04-Nov	S3	63.0	M	A	13-Nov	S2	48.5	M	9
04-Nov	S3	54.5	M	P	11-Dec	S1	43.3	M	37
04-Nov	S3	48.5	M	P	20-Nov	S2	39.5	M	16
04-Nov	S3	54.0	F	P	20-Nov	S2	42.5	M a	16
04-Nov	S3	59.5	M	P	11-Dec	S1	44.6	M	37
04-Nov	S3	54.0	F	P	13-Nov	S2	41.5	F	9
04-Nov	S3	60.0	F	P	20-Nov	S2	47.0	F	16
04-Nov	S3	52.0	M	P	04-Dec	S1	43.1	M	30
04-Nov	S3	49.0	F	P	13-Nov	S1	39.3	F	9
06-Nov	S1	56.0	M	P	23-Nov	S1	42.1	M	17
06-Nov	S1	53.0	M	P	18-Nov	S1	42.4	F a	12
06-Nov	S1	51.0	M	P	27-Nov	S1	39.6	M	21
06-Nov	S1	63.0	F	P	14-Dec	S1	n/a	F	38
06-Nov	S1	59.5	M	P	20-Nov	S1	49.6	M	14
06-Nov	S1	60.0	M	P	23-Nov	S1	43.1	M	17
06-Nov	S1	51.5	M	P	09-Dec	S1	43.8	M	33
06-Nov	S1	46.0	F	P	21-Dec	C1	35.7	M a	45
06-Nov	S1	49.0	M	P	20-Nov	S1	41.7	M	14

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
06-Nov	S1	64.0	M	P	27-Nov	S1	48.2	M	21
06-Nov	S1	41.5	M	P	14-Dec	S1	34.0	M	38
06-Nov	S1	60.0	F	P	28-Dec	S3	48.8	F	52
06-Nov	S1	50.5	M	P	27-Nov	C1	40.0	M	21
06-Nov	S1	62.5	F	P	14-Dec	S1	49.6	F	38
06-Nov	S1	55.5	M	P	20-Nov	S1	45.6	M	14
06-Nov	S1	59.0	F	P	16-Nov	S1	47.8	F	10
06-Nov	S1	52.5	F	P	08-Dec	C1	42.4	F	32
06-Nov	S1	54.5	M	P	13-Nov	S1	40.6	M	7
06-Nov	S1	47.6	F	P	09-Nov	S1	40.6	F	3
06-Nov	S1	51.5	M	P	11-Dec	S3	40.8	M	35
06-Nov	S1	44.0	M	P	13-Nov	S1	34.8	M	7
06-Nov	S1	56.0	M	P	13-Nov	S1	43.2	M	7
06-Nov	S1	46.0	F	P	13-Nov	S1	35.9	M a	7
06-Nov	S1	59.5	F	P	18-Nov	S1	44.4	M a	12
06-Nov	S2	61.0	M	P	11-Dec	S2	45.5	M	35
06-Nov	S2	42.0	M	P	27-Nov	S2	34.7	M	21
06-Nov	S2	55.5	M	A	13-Nov	S1	42.6	M	7
06-Nov	S2	58.0	F	P	13-Nov	S2	46.0	F	7
06-Nov	S2	56.5	F	A	20-Nov	S2	47.5	F	14
06-Nov	S2	52.5	F	P	20-Nov	S2	43.0	M a	14
06-Nov	S2	54.0	M	P	20-Nov	S2	41.5	M	14
06-Nov	S2	54.0	M	P	27-Nov	S1	43.0	M	21
06-Nov	S2	42.5	M	P	23-Nov	S1	35.8	M	17
06-Nov	S2	62.5	M	P	27-Nov	S2	48.0	M	21
06-Nov	S2	61.5	F	P	20-Nov	S2	50.5	F	14
06-Nov	S2	64.0	F	P	27-Nov	S2	50.3	F	21
06-Nov	S2	61.0	M	P	14-Dec	S3	48.0	M	38
06-Nov	S2	60.0	M	A	20-Nov	S2	49.0	M	14
06-Nov	S2	56.5	F	P	11-Dec	S1	46.1	F	35
06-Nov	S3	59.0	F	P	20-Nov	S3	48.0	M a	14
06-Nov	S3	68.0	F	?	25-Nov	S3	54.1	F	19
06-Nov	S3	56.5	F	P	13-Nov	S3	45.5	F	7
06-Nov	S3	61.0	M	P	20-Nov	S3	50.0	M	14
06-Nov	S3	65.0	M	P	20-Nov	S3	53.0	M	14
06-Nov	S3	58.0	M	P	09-Dec	S3	46.0	M	33
06-Nov	S3	49.0	M	P	20-Nov	S2	38.5	M	14
06-Nov	S3	55.0	F	P	20-Nov	S3	44.5	F	14
06-Nov	S3	60.0	F	P	11-Dec	S1	47.8	F	35
06-Nov	S3	52.0	M	P	30-Nov	S3	41.2	M	24
06-Nov	S3	50.5	F	P	20-Nov	S3	43.0	F	14
06-Nov	S3	65.0	M	A	27-Nov	S2	51.1	M	21
06-Nov	S3	43.5	M	P	20-Nov	S3	35.5	M	14
06-Nov	S3	50.0	F	P	13-Nov	S3	41.0	F	7
06-Nov	S3	53.0	M	P	20-Nov	S2	41.0	M	14
06-Nov	S3	70.5	F	P	13-Nov	S3	54.0	F	7
06-Nov	S3	58.5	F	A	27-Nov	S2	47.0	F	21
06-Nov	S3	55.0	M	P	27-Nov	S1	42.2	M	21

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
06-Nov	S3	54.0	M	P	27-Nov	S2	43.6	M	21
06-Nov	S3	57.5	M	P	20-Nov	S2	49.5	M	14
09-Nov	S1	61.0	F	P	08-Jan	S1	46.4	M a	60
09-Nov	S1	49.5	M	P	16-Nov	S1	38.6	F a	7
09-Nov	S1	56.5	M	P	11-Dec	S1	n/a	M	32
09-Nov	S1	53.5	F	A	13-Nov	S1	43.8	F	4
09-Nov	S1	54.0	M	P	13-Nov	S1	42.1	M	4
09-Nov	S1	60.0	F	P	20-Nov	S1	49.2	F	11
09-Nov	S1	56.0	F	A	27-Nov	S1	48.0	F	18
09-Nov	S1	51.0	M	P	08-Dec	C1	39.5	M	29
09-Nov	S1	54.0	M	P	14-Dec	S1	44.3	M	35
09-Nov	S1	46.0	M	P	14-Dec	S1	36.1	M	35
09-Nov	S1	49.0	M	P	27-Nov	C1	39.0	M	18
09-Nov	S1	53.0	F	P	20-Nov	S1	42.7	F	11
09-Nov	S1	58.5	F	P	11-Nov	S1	46.0	F	2
09-Nov	S1	57.0	F	P	28-Dec	S1	n/a	F	49
09-Nov	S1	53.5	F	P	13-Nov	S1	42.6	F	4
09-Nov	S1	48.0	M	A	08-Dec	C1	38.1	M	29
09-Nov	S1	51.5	M	P	21-Dec	S1	41.5	F a	42
09-Nov	S1	73.0	M	P	27-Nov	S1	59.2	M	18
09-Nov	S1	58.5	F	P	11-Nov	S1	46.4	M a	2
09-Nov	S1	51.5	M	P	14-Dec	S1	43.1	M	35
09-Nov	S1	53.0	M	P	13-Nov	S1	41.1	M	4
09-Nov	S1	55.0	F	P	18-Nov	S1	45.7	F	9
11-Nov	S1	64.0	F	P	14-Dec	S1	50.6	F	33
11-Nov	S1	63.0	M	P	18-Nov	S1	48.4	M	7
11-Nov	S1	57.5	F	P	20-Nov	S3	48.0	F	9
11-Nov	S1	57.0	F	P	25-Nov	S1	45.7	F	14
11-Nov	S1	32.5	M	P	27-Nov	S2	24.8	M	16
11-Nov	S1	53.5	F	P	13-Jan	S1	36.8	M a	63
11-Nov	S1	60.0	F	P	20-Nov	S1	51.3	F	9
11-Nov	S1	56.0	M	P	23-Nov	S1	44.0	M	12
11-Nov	S1	53.5	M	P	27-Nov	C1	43.0	M	16
11-Nov	S1	59.5	M	P	28-Dec	S1	40.9	M	47
11-Nov	S1	50.0	M	P	27-Nov	S1	n/a	M	16
11-Nov	S1	51.5	F	P	20-Nov	S1	42.0	M a	9
11-Nov	S1	45.0	M	P	20-Nov	C1	31.1	M	9
11-Nov	S1	59.0	M	P	20-Nov	S1	48.0	F a	9
11-Nov	S1	63.0	F	P	27-Nov	S1	48.6	F	16
11-Nov	S1	53.5	F	P	27-Nov	S1	45.6	F	16
11-Nov	S1	46.5	M	P	23-Dec	S5	35.8	M	42
11-Nov	S1	58.0	F	P	27-Nov	S1	50.0	F	16
11-Nov	S1	61.5	F	P	08-Jan	S1	46.2	F	58
11-Nov	S1	53.0	F	P	18-Nov	S1	45.6	F	7
11-Nov	S1	50.0	M	P	16-Dec	C1	38.7	M	35
11-Nov	S1	51.5	F	P	20-Nov	S1	44.5	F	9
11-Nov	S1	51.0	M	P	18-Nov	S1	39.3	M	7
11-Nov	S1	57.5	M	P	28-Dec	S3	44.6	M	47

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
11-Nov	S1	64.5	F	P	16-Nov	S1	52.3	F	5
11-Nov	S1	57.5	F	P	09-Dec	S1	46.2	F	28
11-Nov	S1	48.0	M	P	25-Nov	S1	37.8	M	14
11-Nov	S1	47.0	M	P	25-Nov	S1	35.3	M	14
11-Nov	S1	56.0	F	P	20-Nov	C1	43.4	F	9
11-Nov	S1	50.0	M	P	11-Dec	S1	39.2	M	30
11-Nov	S1	65.0	F	P	25-Nov	S1	50.1	F	14
11-Nov	S1	58.5	M	P	20-Nov	S1	48.5	M	9
11-Nov	S1	59.0	M	P	27-Nov	C1	45.0	M	16
11-Nov	S1	56.0	F	P	27-Nov	S1	44.5	F	16
11-Nov	S1	65.0	M	P	20-Nov	S1	53.5	M	9
11-Nov	S1	57.5	M	P	21-Dec	S1	46.5	M	40
11-Nov	S1	48.0	M	P	13-Nov	S1	38.3	M	2
11-Nov	S1	52.5	F	P	04-Jan	S1	n/a	F	54
11-Nov	S1	46.0	M	P	18-Nov	S1	36.7	M	7
11-Nov	S1	45.5	F	P	13-Nov	S1	45.9	F	2
11-Nov	S1	46.0	M	P	18-Dec	C1	37.1	F a	37
11-Nov	S1	56.5	F	P	23-Nov	S1	44.2	F	12
11-Nov	S1	48.0	M	P	23-Nov	S1	37.7	M	12
11-Nov	S1	49.0	F	P	27-Nov	S1	40.1	F	16
11-Nov	S1	62.5	F	P	27-Nov	S1	52.3	M a	16
11-Nov	S1	62.0	F	P	28-Dec	S1	47.6	F	47
11-Nov	S1	54.0	F	P	14-Dec	S1	45.2	F	33
11-Nov	S1	63.5	M	A	25-Nov	S1	49.0	M	14
11-Nov	S1	53.0	M	P	23-Nov	S1	42.8	F a	12
11-Nov	S1	49.0	F	P	04-Dec	S1	43.1	F	23
11-Nov	S1	50.5	M	P	16-Nov	S1	39.5	M	5
11-Nov	S1	60.0	M	P	27-Nov	S1	46.2	M	16
11-Nov	S1	56.5	M	P	18-Nov	S1	43.6	M	7
11-Nov	S1	45.0	M	P	30-Nov	S1	35.7	M	19
11-Nov	S1	57.0	F	P	21-Nov	S1	45.8	F	10
11-Nov	S1	51.0	M	P	16-Nov	S1	39.5	M	5
11-Nov	S1	56.0	F	P	18-Nov	S1	43.8	F	7
11-Nov	S1	50.0	M	P	14-Dec	S1	37.5	F a	33
11-Nov	S1	55.0	F	P	16-Nov	S1	44.5	F	5
11-Nov	S1	63.5	F	P	25-Nov	S3	50.1	F	14
11-Nov	S1	65.5	F	P	04-Dec	S1	53.5	F	23
11-Nov	S1	51.5	M	P	20-Nov	S1	40.3	M	9
11-Nov	S1	57.0	M	P	27-Nov	S1	44.7	M	16
11-Nov	S1	68.0	M	P	27-Nov	S1	50.5	F a	16
16-Nov	S1	55.0	M	P	28-Dec	S1	40.6	M	42
16-Nov	S1	44.0	M	P	20-Nov	S1	35.7	M	4
16-Nov	S1	50.0	F	P	02-Dec	C2	41.2	F	16
16-Nov	S1	59.5	F	A	23-Nov	S1	47.1	M a	7
16-Nov	S1	50.5	M	A	20-Nov	S1	42.5	M	4
16-Nov	S1	62.5	M	P	23-Nov	S1	51.3	F a	7
16-Nov	S1	53.0	M	P	27-Nov	S1	41.4	F a	11
16-Nov	S1	57.0	F	P	30-Nov	S1	48.6	F	14

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	MF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
16-Nov	S1	59.0	M	P	18-Nov	S1	43.3	M	2
16-Nov	S1	59.5	F	P	25-Nov	S1	46.0	F	9
16-Nov	S1	56.5	F	A	30-Nov	S1	46.8	F	14
16-Nov	S1	61.5	F	P	25-Nov	S1	48.8	F	9
16-Nov	S1	54.5	F	P	08-Jan	S1	41.7	F	53
16-Nov	S1	42.5	M	P	14-Dec	S1	37.3	M	28
16-Nov	S1	58.5	M	P	23-Nov	S1	45.0	F a	7
16-Nov	S1	63.0	F	A	23-Nov	S1	50.3	F	7
16-Nov	S1	58.0	M	P	23-Nov	S1	45.1	F a	7
16-Nov	S1	51.5	F	P	27-Nov	S1	41.7	F	11
16-Nov	S1	51.0	F	P	08-Dec	C1	42.0	F	22
16-Nov	S1	57.0	F	P	11-Dec	S1	44.4	F	25
16-Nov	S1	57.0	F	P	27-Nov	S1	49.2	F	11
16-Nov	S1	51.5	M	P	20-Nov	S1	43.6	F a	4
16-Nov	S1	52.0	F	P	20-Nov	S1	42.6	F	4
16-Nov	S1	66.0	F	P	14-Dec	S1	50.0	F	28
16-Nov	S1	57.0	F	P	27-Nov	S1	48.2	F	11
16-Nov	S1	54.5	F	P	27-Nov	S1	45.4	F	11
16-Nov	S1	54.0	M	P	08-Dec	C3	42.3	M	22
16-Nov	S1	68.0	F	P	14-Dec	S1	54.1	F	28
16-Nov	S1	61.0	F	P	04-Dec	S1	50.0	F	18
16-Nov	S1	59.0	M	P	09-Dec	S1	45.3	M	23
16-Nov	S1	52.0	F	P	30-Dec	C3	43.2	F	44
16-Nov	S1	52.5	F	P	23-Nov	S1	42.6	F	7
16-Nov	S1	54.0	M	P	25-Nov	S1	42.8	M	9
16-Nov	S1	66.0	M	P	08-Jan	S1	50.7	M	53
16-Nov	S1	61.0	M	P	25-Nov	S1	46.1	M	9
18-Nov	S1	61.5	M	P	27-Nov	S1	50.5	F a	9
18-Nov	S1	51.5	F	P	21-Dec	C2	39.1	F	33
18-Nov	S1	52.5	F	P	02-Dec	S3	45.0	F	14
18-Nov	S1	54.0	M	P	23-Nov	S1	42.7	M	5
18-Nov	S1	61.0	F	P	27-Nov	S1	51.8	F	9
18-Nov	S1	54.0	F	P	08-Dec	C1	44.5	F	20
18-Nov	S1	57.5	F	P	14-Dec	S1	47.3	F	26
18-Nov	S1	47.0	F	P	20-Nov	S1	40.5	M a	2
18-Nov	S1	55.0	F	P	20-Nov	S1	45.7	F	2
18-Nov	S1	60.0	F	P	04-Dec	C1	47.2	F	16
18-Nov	S1	57.0	M	P	08-Jan	C3	43.9	M	51
18-Nov	S1	58.5	F	P	14-Dec	S1	47.2	F	26
18-Nov	S1	55.0	F	P	28-Dec	S1	42.4	M a	40
18-Nov	S1	54.5	M	P	11-Dec	S1	43.1	M	23
18-Nov	S1	47.5	M	P	28-Dec	C1	38.7	M	40
18-Nov	S1	65.0	M	P	23-Nov	S1	47.9	M	5
18-Nov	S1	59.0	M	P	27-Nov	S1	49.0	M	9
18-Nov	S1	54.0	F	P	04-Dec	S1	43.8	F	16
18-Nov	S1	58.0	M	P	30-Nov	S1	44.2	M	12
18-Nov	S1	51.5	F	P	27-Nov	S1	41.5	F	9
18-Nov	S1	51.5	F	P	23-Nov	S1	42.2	F	5

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
18-Nov	S1	58.0	F	P	14-Dec	S1	46.2	F	26
18-Nov	S1	53.0	F	P	14-Dec	S1	44.2	F	26
18-Nov	S1	51.5	M	P	25-Nov	S1	38.3	M	7
18-Nov	S1	64.0	M	P	27-Nov	S1	51.5	M	9
18-Nov	S1	53.5	M	P	08-Dec	C1	41.6	M	20
18-Nov	S1	56.0	M	A	27-Nov	S1	44.0	F a	9
18-Nov	S1	60.5	F	P	23-Nov	S1	47.2	F	5
18-Nov	S1	57.0	M	A	14-Dec	C3	47.2	F a	26
18-Nov	S1	57.0	M	P	20-Nov	S1	45.4	M	2
18-Nov	S1	60.0	M	P	13-Jan	S1	41.9	M	56
18-Nov	S1	64.0	F	P	04-Jan	S1	n/a	F	47
18-Nov	S1	59.0	F	P	18-Jan	C2	46.2	M a	61
23-Nov	S1	49.0	F	P	28-Dec	S3	40.3	F	35
23-Nov	S1	50.0	M	P	30-Nov	S1	39.4	M	7
23-Nov	S1	55.0	F	P	21-Dec	S1	n/a	F	28
23-Nov	S1	60.5	M	P	27-Nov	S1	n/a	M	4
23-Nov	S1	54.0	F	P	27-Nov	S1	47.2	F	4
23-Nov	S1	57.0	F	P	21-Dec	S2	46.1	F	28
23-Nov	S1	66.5	F	P	11-Dec	S1	51.8	F	18
23-Nov	S1	48.0	F	P	18-Dec	S1	37.2	F	25
23-Nov	S1	60.0	F	P	28-Dec	S1	44.8	F	35
23-Nov	S1	59.5	M	P	25-Nov	S1	48.7	F a	2
23-Nov	S1	59.0	M	P	06-Jan	S4	47.1	M	44
23-Nov	S1	53.0	M	P	27-Nov	S1	45.3	F a	4
23-Nov	S1	51.5	F	P	08-Jan	S1	n/a	F	46
23-Nov	S1	58.5	F	P	14-Dec	S1	47.8	F	21
23-Nov	S1	57.5	F	P	28-Dec	C1	n/a	F	35
23-Nov	S1	61.0	M	P	04-Dec	S1	49.3	M	11
23-Nov	S1	53.0	F	P	08-Jan	S1	43.2	F	46
23-Nov	S1	53.5	M	P	18-Dec	S1	41.1	F a	25
23-Nov	S1	57.5	F	P	21-Dec	C1	46.2	F	28
23-Nov	S1	63.0	M	P	11-Dec	S1	48.5	M	18
23-Nov	S1	57.0	M	P	11-Dec	S1	46.7	M	18
23-Nov	S1	63.0	M	P	13-Jan	S1	48.3	M	51
23-Nov	S1	59.5	F	P	27-Nov	S1	49.2	F	4
23-Nov	S1	52.5	F	P	30-Nov	S1	43.5	F	7
23-Nov	S1	58.0	M	P	28-Dec	S3	45.8	M	35
23-Nov	S1	59.0	M	P	16-Dec	S1	46.0	M	23
23-Nov	S1	63.5	F	P	30-Nov	S1	50.7	F	7
23-Nov	S1	68.0	M	P	27-Nov	S1	53.2	M	4
23-Nov	S1	52.5	M	P	04-Jan	C1	40.8	M	42
23-Nov	S1	52.0	M	P	09-Dec	S1	41.1	M	16
23-Nov	S1	45.0	F	P	11-Dec	S1	35.8	F	18
23-Nov	S1	57.0	F	P	04-Dec	S1	48.0	F	11
23-Nov	S1	61.0	F	P	23-Dec	C3	50.8	F	30
25-Nov	C1	n/a	M	P	18-Jan	C1	36.0	M	54
25-Nov	S1	57.5	F	P	04-Dec	S1	47.6	F	9
25-Nov	S1	60.5	M	P	14-Dec	S1	45.3	M	19

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
25-Nov	S1	66.5	F	P	21-Dec	S1	49.5	F	26
25-Nov	S1	65.0	F	P	30-Nov	S1	54.1	F	5
25-Nov	S1	58.0	F	P	28-Dec	C2	44.4	M a	33
30-Nov	C1	48.0	M	P	08-Dec	C1	38.5	M	8
30-Nov	C1	55.0	M	P	04-Jan	C1	46.6	M	35
30-Nov	C1	52.0	F	P	14-Dec	S1	43.5	M a	14
30-Nov	C1	45.5	M	P	04-Dec	S1	46.3	M	4
30-Nov	C1	61.0	F	P	11-Dec	S1	48.3	F	11
30-Nov	C1	55.0	M	P	16-Dec	C1	43.0	M	16
30-Nov	C1	48.5	M	P	21-Dec	S1	38.5	M	21
30-Nov	C1	54.0	M	P	28-Dec	C1	42.4	M	28
30-Nov	C1	45.5	M	P	28-Dec	C1	36.1	M	28
30-Nov	C1	56.5	M	P	11-Dec	S1	43.3	M	11
30-Nov	C1	58.0	F	P	04-Dec	S1	48.2	F	4
30-Nov	C1	54.0	F	P	21-Dec	S1	44.0	F	21
30-Nov	C1	47.5	M	P	08-Jan	S1	38.5	F a	39
30-Nov	C1	36.5	M	P	16-Dec	C1	29.5	M	16
30-Nov	C1	50.5	M	P	28-Dec	S1	37.8	M	28
30-Nov	S1	55.0	M	P	08-Jan	S1	43.1	F a	39
30-Nov	S1	54.5	M	P	18-Dec	S1	42.2	M	18
30-Nov	S1	52.0	F	P	09-Dec	S1	42.7	F	9
30-Nov	S1	49.0	M	P	16-Dec	C1	39.8	F a	16
30-Nov	S1	54.5	M	P	28-Dec	C1	43.8	M	28
30-Nov	S1	61.0	M	P	14-Dec	S1	48.1	M	14
30-Nov	S2	56.5	M	P	28-Dec	S1	43.8	M	28
30-Nov	S3	57.0	F	P	11-Dec	S1	45.5	F	11
30-Nov	S3	58.5	M	P	14-Dec	S1	45.7	M	14
30-Nov	S3	58.5	M	P	11-Dec	S3	45.4	M	11
30-Nov	S3	60.0	F	P	28-Dec	S3	46.8	F	28
30-Nov	S3	41.5	M	P	21-Dec	S2	32.4	M	21
30-Nov	S3	53.0	F	P	11-Dec	S1	43.3	F	11
30-Nov	S3	59.5	F	P	11-Dec	S1	45.8	F	11
30-Nov	S3	52.5	M	P	21-Dec	S1	41.5	M	21
30-Nov	S3	52.0	F	P	04-Jan	S3	41.4	F	35
30-Nov	S3	59.5	F	P	11-Dec	S1	47.3	F	11
30-Nov	S3	54.5	M	P	11-Dec	S1	42.1	M	11
04-Dec	S1	57.0	M	P	18-Dec	S1	45.0	M	14
04-Dec	S1	59.0	F	P	04-Jan	S1	49.1	F	31
04-Dec	S1	53.0	M	P	13-Jan	S1	38.6	M	40
04-Dec	S1	59.0	F	P	11-Dec	S1	47.7	F	7
04-Dec	S1	59.5	F	P	18-Dec	S1	45.5	F	14
04-Dec	S1	52.0	F	P	13-Jan	S1	46.8	F	40
04-Dec	S1	41.5	M	P	08-Jan	S1	34.2	M	35
11-Dec	C1	55.5	F	P	14-Dec	S1	46.0	M a	3
11-Dec	C1	54.5	F	P	08-Jan	S1	44.7	F	28
11-Dec	S1	47.5	M	P	08-Jan	S1	38.7	M	28
11-Dec	S1	57.5	F	P	08-Jan	S1	46.8	F	28
11-Dec	S1	70.0	M	P	14-Dec	S1	55.4	M	3

Appendix 6. Summary of disk tag recoveries in the Salmon River system, 1987-88.

Application sample					Recovery sample				
Date	Reach b	NF length (cm)	Sex	Adipose fin	Date	Reach b	POH length (cm)	Sex	Time out (days)
11-Dec	S1	54.5	F	P	28-Dec	S1	43.1	F	17
11-Dec	S1	56.0	F	P	08-Jan	S1	46.0	F	28
11-Dec	S1	51.5	F	P	14-Dec	S1	40.0	M a	3
11-Dec	S1	51.0	F	P	14-Dec	S1	40.6	F	3
11-Dec	S1	48.5	M	P	04-Jan	S1	38.1	M	24
18-Dec	S1	57.0	F	P	08-Jan	S1	43.2	F	21
18-Dec	S1	50.0	F	P	28-Dec	S1	40.0	F	10
18-Dec	S1	57.0	F	P	28-Dec	S1	45.1	F	10
18-Dec	S1	59.0	M	P	21-Dec	S1	46.7	F a	3
18-Dec	S1	54.0	M	P	28-Dec	S1	42.8	M	10
18-Dec	S1	53.5	F	P	08-Jan	S1	42.2	F	21
18-Dec	S1	49.0	F	P	08-Jan	S1	39.6	F	21

Females initially identified as male: 24 (14.1%)
Males initially identified as female: 21 (11.8%)

Mean: 19
Maximum: 63
Minimum: 2

POH and FL Regressions:

-Adult Males: POH = 0.73 NF + 3.05
NF = 1.18 POH + 4.10

-Adult Females: POH = 0.72 NF + 4.94
NF = 1.16 POH +3.22

a. Incorrect sex identification during disk tag application.

b. Salmon River: S1 - below Coghlan Cr.
S2 - Coghlan Cr. to 64 Ave.
S3 - 64 Ave. to 56 Ave.
S4 - 56 Ave. to 248 St.
S5 - 248 St. to 256 St.
S6 - Above 256 St.

Coghlan Creek: C1 - Salmon R. to Hwy. 1.
C2 - Hwy. 1 to 248 St.
C3 - 248 St. to 64 Ave.
C4 - 64 Ave. to 256 St.
C5 - Above 256 St.

Appendix 7a. Summary of live observations and dead counts of coho salmon in the Salmon River, 1987-88.

			Dead recoveries								
			Adipose present			Adipose absent			Adults		
Date	Reach	Live count	Male	Female	Jack	Male	Female	Jack	Total	Disk tag and secondary mark	Secondary mark only
04-Nov	S1	13	2	1	0	0	0	0	3	2	0
06-Nov	S1	15	5	1	0	0	0	0	6	0	0
	S2	3	0	1	0	0	1	0	2	2	0
09-Nov	S1	57	8	6	0	1	0	0	15	2	0
11-Nov	S1	71	7	9	0	1	0	0	17	5	0
13-Nov	S1	-	29	28	0	2	2	0	61	17	0
	S2	-	6	9	0	1	0	0	16	3	0
	S3	30	18	31	0	1	0	0	50	4	0
16-Nov	S1	51	3	4	0	0	0	0	7	6	0
18-Nov	S1	18	9	13	0	0	0	0	22	10	0
20-Nov	S1	-	45	28	0	1	0	0	74	22	1
	S2	17	22	11	0	1	1	0	35	12	0
	S3	65	63	33	0	6	1	0	103	7	0
23-Nov	S1	45	15	14	0	1	2	0	32	17	0
25-Nov	S1	-	7	7	0	1	0	0	15	11	0
	S3	56	48	104	3	5	4	1	161	2	0
	S4	-	11	5	0	0	0	0	16	0	0
	S5	13	0	0	0	0	0	0	0	0	0
27-Nov	S1	27	60	85	0	2	8	1	155	33	0
	S2	3	23	25	0	3	3	0	54	10	0
30-Nov	S1	71	5	10	0	0	2	0	17	8	0
	S3	36	18	14	0	0	0	0	32	1	0
02-Dec	S2	1	2	2	0	0	0	0	4	0	0
	S3	15	16	12	0	1	0	0	29	1	0
	S4	2	3	5	0	0	1	0	9	0	0
	S5	3	3	0	1	0	0	0	3	0	0
04-Dec	S1	-	24	22	0	0	0	0	46	10	1
09-Dec	S1	-	6	5	2	0	0	0	11	6	0
	S3	0	8	14	0	0	1	0	23	1	0
	S4	1	1	1	0	0	0	0	2	0	0
11-Dec	S1	29	51	77	4	0	0	0	128	25	0
	S2	1	4	8	0	0	0	0	12	1	0
	S3	21	42	65	2	0	0	0	107	2	0
14-Dec	S1	-	35	59	2	0	0	0	94	27	0
	S2	0	2	4	0	0	0	0	6	0	0
	S3	7	12	16	0	0	0	0	28	1	0
	S4	5	4	8	0	0	0	0	12	0	0
	S5	-	1	5	0	0	1	0	7	0	0
16-Dec	S1	0	2	2	0	0	0	0	4	1	0
18-Dec	S1	0	4	6	0	0	0	0	10	5	0
21-Dec	S1	3	10	15	0	0	0	0	25	8	0
	S2	6	1	2	0	0	0	0	3	2	0
	S3	-	11	29	0	0	0	0	40	0	0
23-Dec	S4	0	13	26	2	0	0	0	39	0	0
	S5	1	1	3	0	0	0	0	4	1	0

Appendix 7a. Summary of live observations and dead counts of coho salmon in the Salmon River, 1987-88.

			Dead recoveries								
			Adipose present			Adipose absent				Adults	
Date	Reach	Live count	Male	Female	Jack	Male	Female	Jack	Total	Disk tag and secondary mark	Secondary mark only
28-Dec	S1	7	15	23	4	0	0	0	38	12	0
	S2	3	4	1	1	0	0	0	5	0	0
	S3	9	30	46	2	0	0	0	76	5	0
30-Dec	S4	0	5	10	0	0	0	0	15	0	0
	S5	1	2	1	0	0	0	0	3	0	0
04-Jan	S1	3	10	19	0	0	0	0	29	4	1
	S2	0	1	1	0	0	0	0	2	0	0
	S3	1	11	12	0	0	0	0	23	1	1
06-Jan	S4	0	8	14	6	0	0	0	22	1	0
	S5	1	3	11	1	0	0	0	14	0	0
08-Jan	S1	0	14	32	5	0	0	0	46	16	0
	S2	0	0	0	0	0	0	0	0	0	0
13-Jan	S1	1	4	3	0	0	0	0	7	5	0
	S2	0	0	0	0	0	0	0	0	0	0
	S3	1	4	1	0	0	0	0	5	0	0
18-Jan	S1	0	8	10	1	0	0	0	18	0	0
	S2	0	0	0	0	0	0	0	0	0	0
	S3	0	5	16	0	0	0	0	21	0	0
19-Jan	S4	0	6	10	0	0	0	0	16	0	0
	S5	0	0	0	0	0	0	0	0	0	0
Total	S1	-	378	479	18	9	14	1	880	252	3
	S2	-	65	64	1	5	5	0	139	30	0
	S3	-	286	393	7	13	6	1	698	25	1
	S4	-	51	79	8	0	1	0	131	1	0
	S5	-	10	20	2	0	1	0	31	1	0
	Total		790	1,035	36	27	27	2	1,879	309	4

Appendix 7b. Summary of live observations and dead counts of coho salmon in Coghlan Creek, 1987-88.

			Dead recoveries								
										Adults	
			Adipose present			Adipose absent					
Date	Reach	Live count	Male	Female	Jack	Male	Female	Jack	Total	Disk tag and secondary mark	Secondary mark only
13-Nov	C1	23	17	22	0	0	1	0	40	0	0
18-Nov	C1	17	0	0	0	0	1	0	1	0	0
20-Nov	C1	27	51	42	4	6	2	0	101	2	0
	C2	38	1	1	0	0	1	0	3	0	0
	C3	11	0	0	0	0	0	0	0	0	0
	C4	4	0	0	0	0	0	0	0	0	0
25-Nov	C1	-	1	0	0	0	0	0	1	0	0
27-Nov	C1	-	100	81	1	10	6	0	197	4	0
	C2	34	10	5	0	1	1	0	17	1	0
30-Nov	C1	26	11	8	0	0	2	0	21	0	0
02-Dec	C1	-	0	0	0	1	0	0	1	0	0
	C2	48	13	9	0	0	1	0	23	1	0
	C3	-	5	3	0	0	0	0	8	0	0
	C4	-	2	1	0	0	0	0	3	0	0
	C5	13	3	6	0	0	0	0	9	0	0
04-Dec	C1	-	19	30	2	0	1	0	50	1	0
08-Dec	C1	11	88	124	0	3	1	1	216	7	0
	C2	-	6	13	0	0	1	1	20	0	0
	C3	23	12	29	4	0	5	2	46	1	0
	C4	31	14	5	0	2	2	3	23	0	0
	C5	2	3	5	0	0	0	0	8	0	0
14-Dec	C3	-	9	12	0	0	1	0	22	1	0
	C4	-	16	15	0	0	0	0	31	0	0
	C5	5	5	1	0	0	1	0	7	0	0
16-Dec	C1	19	51	59	0	3	1	0	114	4	0
	C2	17	7	16	0	1	0	0	24	0	0
18-Dec	C1	3	0	2	0	0	0	0	2	1	0
21-Dec	C1	-	18	43	1	0	0	0	61	2	0
	C2	3	4	14	1	0	0	0	18	1	0
23-Dec	C3	9	11	26	1	0	0	0	37	1	0
	C4	-	6	8	2	0	0	0	14	0	0
	C5	1	6	11	1	0	1	0	18	0	0
28-Dec	C1	3	30	64	4	1	0	0	95	5	0
	C2	3	9	16	2	0	0	0	25	1	0
30-Dec	C3	6	2	13	0	0	1	0	16	1	0
	C4	-	2	0	1	0	0	0	2	0	0
	C5	-	3	9	1	0	0	0	12	0	0
04-Jan	C1	3	19	9	2	0	0	0	28	2	0
	C2	0	3	1	0	0	0	0	4	0	0
08-Jan	C3	0	5	4	2	0	0	0	9	1	0
	C4	1	6	6	1	0	0	0	12	0	0
	C5	2	3	3	1	0	0	0	6	0	0
13-Jan	C1	0	4	8	0	0	0	0	12	0	0
	C2	0	4	4	0	0	0	0	8	0	0
18-Jan	C1	0	15	17	4	0	0	0	32	1	0

Appendix 7b. Summary of live observations and dead counts of coho salmon in Coghlan Creek, 1987-88.

			Dead recoveries								
										Adults	
			Adipose present			Adipose absent					
Date	Reach	Live count	Male	Female	Jack	Male	Female	Jack	Total	Disk tag and secondary mark	Secondary mark only
	C2	0	3	11	0	0	0	0	14	1	0
19-Jan	C3	0	3	5	0	0	0	0	8	0	0
	C4	0	0	2	1	0	0	0	2	0	0
	C5	0	0	2	0	0	0	0	2	0	0
Total	C1	-	424	509	18	24	15	1	972	29	0
	C2	-	60	90	3	2	4	1	156	5	0
	C3	-	47	92	7	0	7	2	146	5	0
	C4	-	46	37	5	2	2	3	87	0	0
	C5	-	23	37	3	0	2	0	62	0	0
	Total	372	600	765	36	28	30	7	1,423	39	0

Appendix 8. Spawning success of coho adult female spawning ground recoveries, 1987-88.

	Percent spawned			Total	
	0%	50%	100%	Number	% spawned
Disk tag or secondary mark present	20	4	142	166	86.7%
	12.0%	2.4%	85.5%	-	-
Unmarked	1	2	128	131	98.5%
	0.8%	1.5%	97.7%	-	-
Total	21	6	270	297	-
	7.1%	2.0%	90.9%	-	-

Appendix 9. Observed and estimated coho adult escapement, by CWT code, in the Salmon River system, 1987-88.

		CWT code				
	Total	02 38 40	02 38 39	02 38 38	No CWT	CWT lost
Estimated AFC escapement	405	-	-	-	-	-
No. AFCs recovered	112	-	-	-	-	-
Observed CWT codes	102 a	27	28	24	22	1
Estimated escapement	405	109	113	97	87	-

a. Excludes 8 lost before processing and 2 recovered without heads.

Appendix 10. Incidence of CWT loss by carcass condition and eye status in coho adults recovered on the Salmon River system spawning grounds, 1987-88.

Group	Sample size	CWT absent	CWT loss (%)
Condition 1	21	4	19.0%
Condition 2	54	12	22.2%
Condition 3	27	4	14.8%
Condition 4	2	0	0.0%
Eyes present	85	15	17.6%
Eyes absent	19	5	26.3%

Appendix 11. Sex and age composition and mean length of Salmon River coho salmon, 1987-88.

Sample	Age	Sex	n	Rel. %	Mean length (cm)	s
Application sample a	Total	M	799	60.5	51.8 b	7.3
		F	521	39.5	55.7 b	4.5
Census sample	3/2	M	159	46.8	43.0 c	4.9
		F	175	51.5	45.5 c	3.9
	2/2	M	6	1.8	26.1 c	1.5
	Total	M	287	49.1	42.0 b	5.7
		F	298	50.9	45.5 b	3.9

a. Not adjusted for sex identification errors.
b. Nose-fork length.
c. Postorbital-hypural length.